

What is claimed is:

1. A cam mechanism comprising:
a cam ring; and
a linearly movable frame movable by said cam ring
5 along an optical axis of an optical system without
rotating, by engagement of a plurality of cam grooves
located on said cam ring with a plurality of complementing
cam followers located on said linearly movable frame when
said cam ring is rotated, said linearly movable frame
10 supporting at least one optical element of said optical
system,

wherein said plurality of cam grooves are located
at different positions in both said optical axis direction
and a circumferential direction of said cam ring, and
15 respectively trace substantially a same reference cam
diagram; and

wherein said plurality of complementing cam
followers are located at different positions in both said
optical axis direction and a circumferential direction
20 of said linearly movable frame, and are engageable in said
plurality of cam grooves, respectively.

2. The cam mechanism according to claim 1,
wherein said plurality of cam grooves comprises a front
cam groove and a rear cam groove positioned behind said
25 front cam groove in said optical axis direction, and

wherein said plurality of complementing cam followers comprises a front cam follower and a rear cam follower positioned behind said front cam follower in said optical axis direction and are engageable in said front cam groove and said rear cam groove, respectively.

3. The cam mechanism according to claim 1, wherein at least one cam groove of said plurality of cam grooves intersect another cam groove thereof; and

wherein at least one cam follower of said plurality of complementing cam followers remains engaged in a corresponding one of said plurality of cam grooves when another cam follower of said plurality of complementing cam followers passes through an intersection of said cam grooves during a rotation of said cam ring.

15 4. The cam mechanism according to claim 3,

wherein said reference cam diagram includes a zooming range and is configured to perform a zooming operation; and

wherein said intersection is outside said zooming range.

20 5. The cam mechanism according to claim 1, wherein said cam ring comprises a plurality of cam groove groups, each cam groove group including at least two cam grooves of said plurality of cam grooves located at different positions both in said optical axis direction

and said circumferential direction of said cam ring, and respectively trace substantially a same reference cam diagram; and

wherein said linearly movable frame comprises a
5 plurality of cam follower groups, each cam follower group including at least two complementing cam followers of said plurality of complementing cam followers located at different positions both in said optical axis direction and said circumferential direction of said linearly
10 movable frame.

6. The cam mechanism according to claim 5, wherein at least one of said at least two cam grooves of one said cam groove group intersects with another of said at least two cam grooves of another said cam groove group,
15 said another said cam groove adjacent to said at least one said cam groove in said circumferential direction.

7. The cam mechanism according to claim 1, wherein each cam groove of said plurality of cam grooves has at least one end opening at at least one of opposite
20 ends of said cam ring, so as not to include an entire portion of said reference cam diagrams; and

wherein at least one cam follower of said plurality of complementing cam followers remains engaged in a corresponding cam groove of said plurality of cam grooves
25 while another cam follower of said plurality of

complementing cam followers comes out of said end opening
of a corresponding another cam groove of said cam grooves,
during a rotation of said cam ring.

8. The cam mechanism according to claim 1,
5 wherein said optical system comprises a plurality of
movable lens groups movable in said optical axis direction
while changing a distance therebetween by a rotation of
said cam ring, said linearly movable frame holding at
least one of said plurality of movable lens groups.

10 9. The cam mechanism according to claim 1,
wherein said optical system comprises a photographing
lens system.